

## Chapter 4 Future Demand and Land Use

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This chapter summarizes the methodology used to obtain future year forecasts for various modes in the City of Tigard.

The plan for street improvements within Tigard depends on determining existing needs and needs of future growth. As a first step in assessing future needs, Metro's urban area traffic forecast model and land use forecast for 2015 was identified as a source for determining future traffic volumes in Tigard. This traffic forecast model translates land uses into roadway volume projections. These traffic volume projections form the basis for identifying potential roadway deficiencies and for evaluating alternative circulation improvements. This section describes the forecasting process, including key assumptions and the analysis of the land use scenario developed from the current Comprehensive Plan development designations and allowed densities. Future change of these variables could significantly change the future travel forecast.

The 2015 forecast was refined to include detailed information about Tigard buildout. This 2015 forecast was used for detailed operational analysis<sup>1</sup>. The refined 2015 forecast was used in concert with the updated 2020 Metro forecasts. This chapter compares the land use inputs between refined 2015 and 2020.

### PROJECTED LAND USES

Land use is a key factor in how the transportation system operates. The amount of land that is developed, the type of land uses and how the land uses are mixed together have a direct relationship to expected demands on the transportation system. Understanding the amount and type of land use is critical to taking actions to maintain or enhance transportation system operation.

Projected land uses were developed for all areas within the urban growth boundary reflecting the comprehensive plan and Metro's land use assumptions for year 2015. Complete land use data sets were developed for the following conditions:

- Existing Base 1994 Conditions
- Year 2015

The base year model is updated every few years. For this study effort, the available base model provided by Metro was for 1994. Land uses were inventoried throughout Tigard (and the adjacent jurisdictions) by Metro and then again by the City of Tigard (the City conducted a detailed inventory of commercial uses in three key

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<sup>1</sup> All references to 2015 in this document refer to the refined Tigard land use 2015 model and its co-use with updated 2020 forecasts.

areas: Tigard Triangle, ORE 99W, Sequoia Parkway area). This land use database includes the number of dwelling units, number of retail employees and number of other employees and is based on Metro's data and was adjusted to reflect the results of the City's inventory. Table 4-1 summarizes the adjusted land uses for existing conditions and the future scenario in the Tigard area.<sup>2</sup> A detailed summary of the land uses for each Transportation Analysis Zone (for both the 1994 and 2015 model years) is included in the appendix. As the land use data is updated in the future, TSP updates can reflect current conditions and new forecasts.

**Table 4-1**  
**Tigard Area Adjusted Land Use Summary**

<i>Land Use</i>	<i>1994</i>	<i>Modified 2015</i>	<b>Growth</b>	<b>Percent Increase</b>
Households	21,765	32,481	10,716	+49%
Retail Employees	9,152	13,257	4,105	+45%
Other Employees	33,553	50,382	16,829	+50%

Source: Metro/City of Tigard

The land use for 2015 used in this study was refined from the base Metro 2015 data. Year 2020 land uses and trip generation were compared to the modified 2015 information. Table 4-2 summarizes the vehicle trip generation for the base 1994 forecast, future 2015 Metro forecast, modified 2015 Tigard forecast and the Metro 2020 forecast. The modified 2015 forecast generated the greatest number of vehicle trips and was used for the TSP. For the detailed study of Tigard streets, the modified 2015 forecast represented near build out, worst case conditions and provides a reasonable assessment of motor vehicle needs within the city (which the forecast was primarily used to determine). More detailed forecasting of the 2020 for regional conditions could be undertaken following this TSP analysis, but it is unlikely (based upon the trip generation) to generate substantially different needs. This would best be undertaken following Metro's adoption of the RTP, and would be a minor update to this TSP.

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<sup>2</sup> Based on Metro's 2015 land use forecasts.

**Table 4-2**  
**Forecasted Vehicle Trips in Tigard**  
**PM Peak Hour**

Scenario	Peak Hour Vehicle Trips
1994 Base Model	34,500
2015 Metro Model	46,000
2020 Metro Model	48,500
2015 Modified Tigard Model	52,600

If land uses are significantly changed in proportion to each other (i.e. there is a significant increase in retail employment relative to households), there will be a shift in the overall operation of the transportation system. Retail land uses generate significantly higher numbers of trips than do households and other land uses. The location and design of retail land uses in a community can greatly affect transportation system operation. Additionally, if a community is homogeneous in land use character (i.e. all employment, all residential), the system must support export of trip making. Typically, there should be both residential type land uses as well as employment type land uses so that some residents may work locally, reducing the need for residents to commute long distances to work. Tigard has a mix of land uses, however, many residents must travel outside the City for employment opportunities.

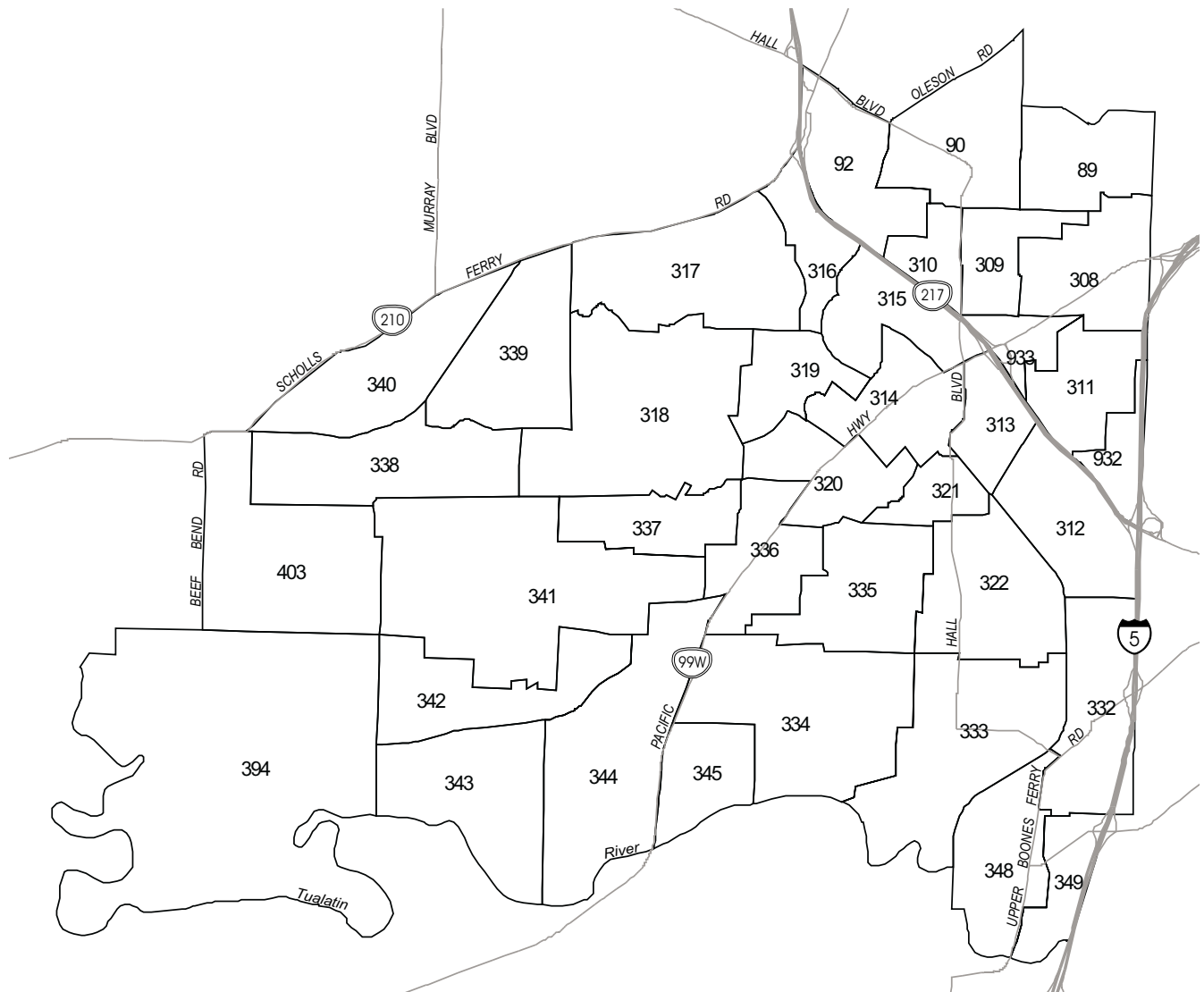
Table 4-1 indicates that a significant amount of growth is expected in Tigard area in the coming years. These land use quantities should be monitored to make sure that Tigard is working to achieve a balance of land use that is compatible with the available transportation system. This TSP balances transportation needs with the forecasted 2015 land uses.

**Transportation Analysis Zones:** For traffic forecasting, the land use data is stratified into geographical areas called traffic analysis zones (TAZ's) which represent the sources of vehicle trip generation. There are about 30-40 Metro TAZ's which represent Tigard and its vicinity (Figure 4-1). These 30-40 TAZ's were disaggregated, as part of this plan, into about 130-140 TAZ's to more specifically represent land use in and around Tigard. The original Metro and disaggregated model zone boundaries for Tigard are shown in Figure 4-2. Metro uses EMME/2, a computer based program for transportation planning, to process the large amounts of data for the Portland Metropolitan area.

Land uses were inventoried throughout Tigard by Metro and adjusted to reflect Tigard's more detailed land use inventory in 2015. The adjustments reflected what was termed to be "near buildout". This land use data base includes the number of dwelling units, number of retail employees and number of other employees. Table 4-3 summarizes the land uses for existing conditions and the future scenario by transportation analysis zones (TAZ's).



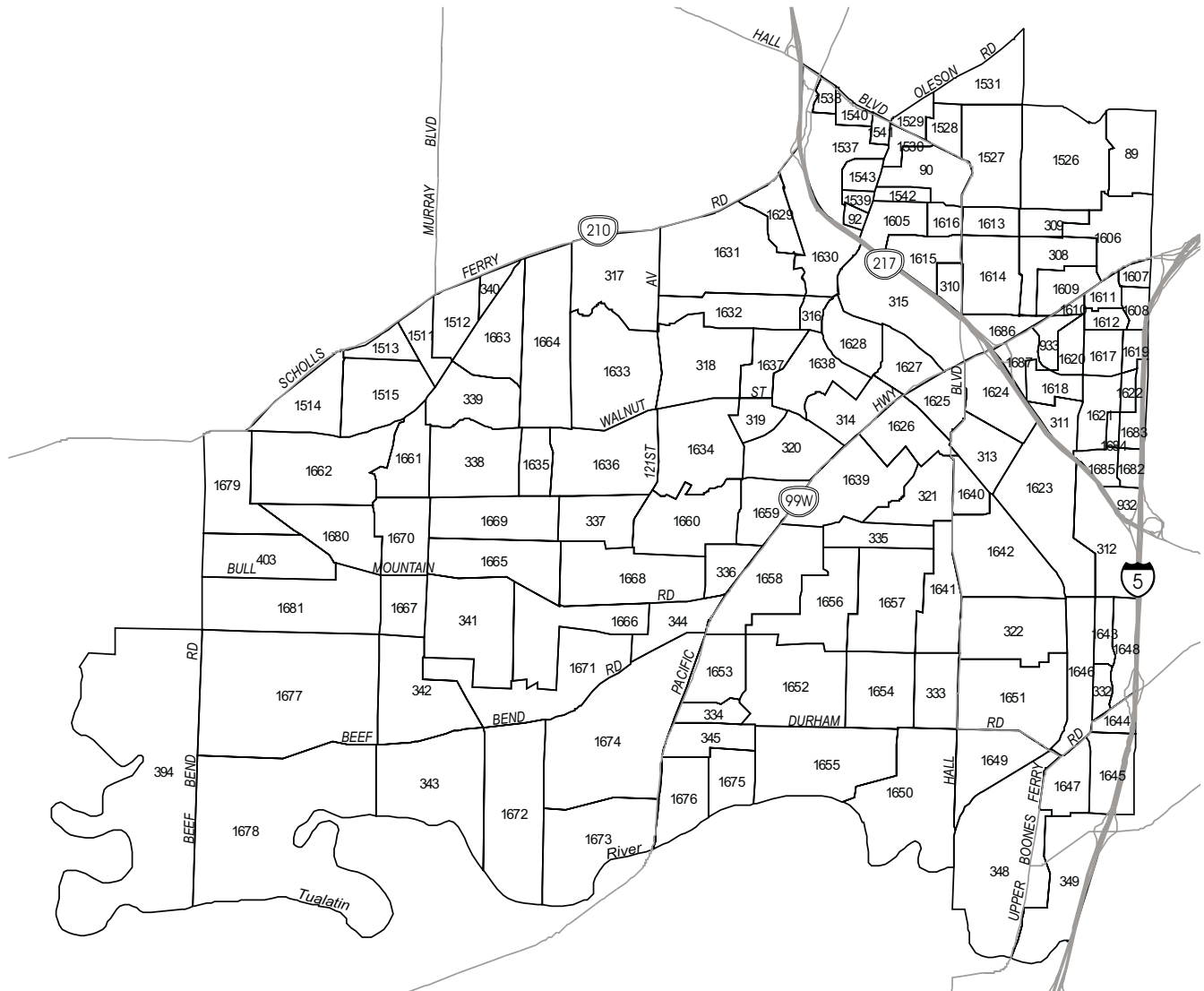
**CITY OF TIGARD  
Transportation  
System Plan**



**Figure 4-1  
METRO TAZ**



**CITY OF TIGARD**  
**Transportation**  
**System Plan**



**Figure 4-2**  
**DISAGGREGATED TIGARD TAZ**

**Table 4-3**  
**Tigard Land Use Summary**

TAZ	<i>Households</i>		<i>Retail Employees</i>		<i>Other Employees</i>	
	<i>1994</i>	<i>2015</i>	<i>1994</i>	<i>2015</i>	<i>1994</i>	<i>2015</i>
67	888	958	3	3	61	76
89	191	217	0	0	17	23
90	299	409	3	4	261	489
92	0	9	143	207	273	519
308	185	195	28	28	21	27
309	77	78	1	1	9	11
310	69	96	2	11	4	22
311	33	37	0	400	58	58
312	0	22	12	12	1,193	1,363
313	3	32	62	51	1,208	1,306
314	160	184	24	24	117	147
315	624	825	212	293	647	1,165
316	77	76	22	24	64	91
317	683	705	161	141	955	1,096
318	303	321	0	0	28	33
319	58	68	0	0	7	16
320	225	251	72	72	100	491
321	120	251	0	0	406	416
322	324	158	0	0	433	518
332	0	1	18	18	422	600
333	125	243	0	5	3	42
334	223	262	43	59	69	166
335	86	167	0	1	2	21
336	170	201	63	70	152	219
337	11	206	0	0	7	40
338	66	163	0	0	4	11
339	66	254	1	2	11	46
340	239	309	0	1	0	139
341	199	294	0	0	27	40
342	269	390	6	5	45	60
343	105	265	0	0	0	102
344	92	260	4	15	19	101
345	223	368	331	397	111	174
394	25	26	0	0	17	20
403	81	231	0	1	17	53
932	0	10	42	42	399	941
933	5	9	92	137	40	78
1511	61	194	0	2	0	104
1512	207	374	0	6	0	331
1513	45	130	0	0	0	24
1514	26	503	0	3	0	167
1515	33	178	1	5	41	298
1526	364	517	0	0	39	91

TAZ	Households		Retail Employees		Other Employees	
	1994	2015	1994	2015	1994	2015
1527	412	487	1	1	87	104
1528	92	130	0	0	12	22
1530	54	146	5	5	496	653
1537	8	115	1,406	2,064	2,686	5,167
1538	97	103	153	149	292	373
1539	0	0	164	142	314	355
1540	25	44	316	418	604	1,048
1541	6	20	78	143	149	357
1542	30	42	152	186	290	467
1543	1	3	52	57	99	144
1605	24	31	1,226	1,084	2,343	2,715
1606	188	241	109	135	80	129
1607	2	10	97	102	71	97
1608	4	22	0	242	168	231
1609	198	236	349	363	110	156
1610	2	18	24	54	18	51
1611	1	29	95	139	70	132
1612	2	45	0	298	170	285
1613	86	93	1	2	8	24
1614	269	308	2	4	26	59
1615	61	92	25	86	38	170
1616	39	63	9	34	14	66
1617	43	61	0	100	188	286
1618	7	37	0	600	41	41
1619	7	13	0	0	116	300
1620	11	16	202	278	44	78
1621	39	77	0	0	165	180
1622	1	16	161	200	54	137
1623	221	323	12	12	2,130	2,800
1624	32	76	61	101	1,189	1,326
1625	206	315	400	500	270	400
1626	269	324	147	250	716	1,019
1627	299	334	36	45	176	283
1628	255	330	20	41	62	162
1629	0	6	73	72	312	368
1630	29	27	131	218	377	830
1631	635	689	89	74	529	573
1632	194	230	22	20	137	162
1633	588	607	0	0	60	64
1634	250	354	0	0	14	46
1635	24	117	0	0	1	27
1636	192	480	0	0	10	93
1637	45	43	1	1	186	182
1638	119	137	0	0	94	131
1639	485	511	283	350	296	375

TAZ	<i>Households</i>		<i>Retail Employees</i>		<i>Other Employees</i>	
	1994	2015	1994	2015	1994	2015
1640	29	102	0	0	24	101
1641	209	358	0	0	85	141
1642	317	533	0	0	60	407
1643	0	5	42	42	422	502
1644	1	3	26	26	466	466
1645	1	9	113	113	3,001	3,552
1646	2	15	129	129	2,999	3,986
1647	4	11	149	149	500	617
1648	1	26	312	433	317	843
1649	40	75	11	20	76	20
1650	62	112	11	10	76	10
1651	394	521	2	12	14	12
1652	548	655	5	8	26	8
1653	259	446	18	247	95	127
1654	432	467	4	4	19	27
1655	472	520	7	7	33	45
1656	316	402	0	1	5	28
1657	261	404	3	3	53	89
1658	451	584	74	83	177	261
1659	148	172	224	224	128	128
1660	258	310	0	0	96	104
1661	15	106	0	0	3	13
1662	127	466	0	0	4	45
1663	526	689	2	4	32	81
1664	379	522	4	4	56	86
1665	116	277	0	0	22	45
1666	60	312	0	0	11	47
1667	73	112	0	0	9	14
1668	180	307	0	0	24	42
1669	53	259	0	0	2	32
1670	60	114	0	0	11	18
1671	38	362	1	5	12	54
1672	74	223	0	0	18	111
1673	548	645	8	13	39	89
1674	1,717	1,903	186	186	444	489
1675	116	155	13	17	4	7
1676	392	468	23	33	8	14
1677	28	29	0	0	16	18
1678	55	57	0	0	25	29
1679	21	349	0	1	1	69
1680	54	182	0	1	13	46
1681	92	299	0	1	20	71
1682	6	28	35	35	247	600
1683	10	20	60	60	426	569
1684	4	12	29	29	208	241

TAZ	Households		Retail Employees		Other Employees	
	1994	2015	1994	2015	1994	2015
1685	1	27	64	64	455	700
1686	9	20	257	335	113	191
1687	10	15	87	300	38	69
1688	115	296	2	49	4	82
1689	89	389	0	0	18	248
<b>Total</b>	<b>21,765</b>	<b>32,481</b>	<b>9,152</b>	<b>13,257</b>	<b>33,553</b>	<b>50,382</b>

Source: Metro/City of Tigard

A comparison of the modified 2015 land use assumptions to 2020 land use assumptions indicates that the 2020 forecast assumes more households, more retail employees and fewer other employees than the modified 2015 forecast. Key areas where discrepancies occurred were the Washington Square area (more retail employees and fewer other employees in 2020), Downtown (more “other” employees in 2020), Sequoia Parkway area (significantly fewer “other” employees in 2020) and Tigard Triangle (significantly fewer “other” employees in 2020). Detail regarding the trip generation by TAZ is provided in the appendix.

## METRO AREA TRAFFIC MODEL

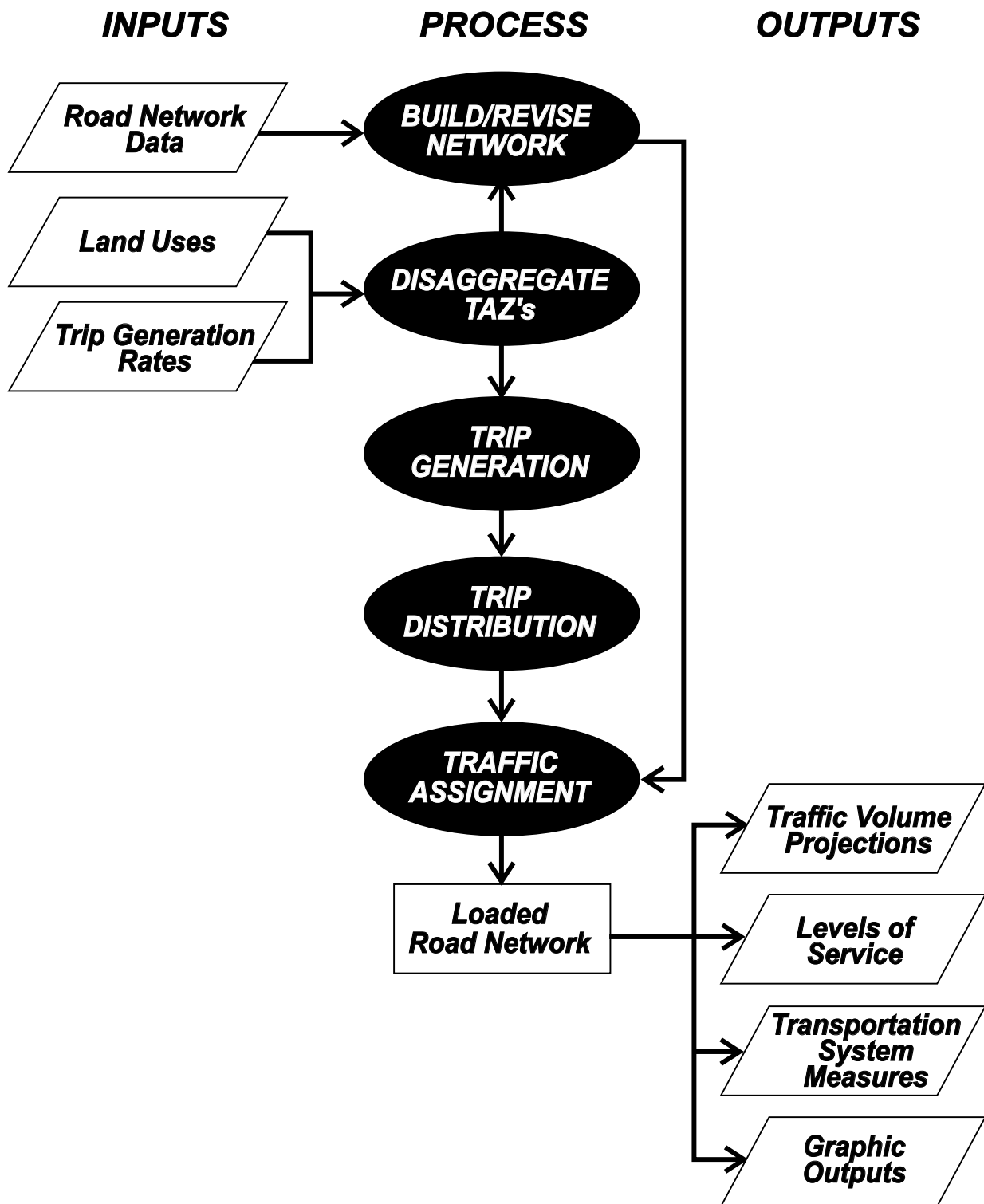
The development of future traffic system needs for Tigard depends on the ability to accurately forecast travel demand resulting from estimates of future population and employment for the City. The objective of the transportation planning process is to provide the information necessary for making decisions on when and where improvements should be made in the transportation system to meet travel demands.

Metro has developed an urban area travel demand model as part of the Regional Transportation Plan Update process to help identify street and roadway needs. Traffic forecasting can be divided into several distinct but integrated components that represent the logical sequence of travel behavior (Figure 4-3). These components and their general order in the traffic forecasting process follow:

- Trip Generation
- Trip Distribution
- Mode Choice
- Traffic Assignment

The initial roadway network used in the traffic model was the existing streets and roadways. Future land use scenarios were tested and roadway improvements were added in to mitigate traffic conditions, using programmed improvements as a starting basis. Forecasts of PM peak hour traffic flows were produced for every major roadway segment within the Tigard area. Traffic volumes are projected on most arterials and collector streets. Some local streets are included in the model, but many are represented by centroid connectors in the model process.

**Trip Generation.** The trip generation process translates land use quantities (in numbers of dwelling units and retail and other employment) into vehicle trip ends (number of vehicles entering or leaving a TAZ) using trip generation rates established during the model verification process. The trip rates were based upon



**Figure 4-3**  
**TRAFFIC FORECASTING**  
**MODEL PROCESS**

Institute of Transportation Engineers research<sup>3</sup> and documentation and adjusted to suit the Portland area in the calibration process. PM peak hour trip rates used in the Metro model are summarized in Table 4-4.

**Table 4-4**  
**Approximate Average PM Peak Hour Trip Rates Used in Metro Model**

<i>Unit</i>	<i>Average Trip Rate/Unit</i>		
	<i>In</i>	<i>Out</i>	<i>Total</i>
Household	0.43	0.19	0.62
Retail Employee	0.78	0.69	1.47
Other Employee	0.07	0.29	0.36

Source: Metro

Table 4-5 illustrates the estimated growth in daily vehicle trips generated within the Tigard, between 1994 and 2015. It indicates that vehicle trip generation in Tigard would grow by approximately 50 percent between 1994 and 2015 if the land develops according to the assumptions made. Assuming a 20 year time horizon to the 2015 scenario, this represents a growth rate of about 2 percent per year.

**Table 4-5**  
**Existing and Future Projected External Trip Generation\***  
**PM Peak Hour Vehicle Trips**

<i>Trips</i>	<i>1994</i>	<i>Modified 2015</i>	<i>2020</i>	<i>2015M -1994 Growth</i>	<i>Percent Increase</i>
Tigard Area	34,447	52,606	48,518	18,159	+53%

Source: Metro/City of Tigard

NOTE: \* - External trips refer to model trips that exit a Tigard centroid

**Trip Distribution.** This step estimates how many trips travel from one zone in the model to any other zone. The distribution is based on the number of trip ends generated in each zone pair, and on factors that relate the likelihood of travel between any two zones to the travel time between the zones.

In projecting long-range future traffic volumes, it is important to consider potential changes in regional travel patterns. Although the locations and amounts of traffic generation in Tigard are essentially a function of future land use in the city, the distribution of trips is influenced by growth in neighboring areas such as Portland, Beaverton, Lake Oswego, Tualatin, etc. External trips (trips which have either an origin or destination in Tigard and the other trip end outside Tigard) and through trips (trips which pass through Tigard and have neither an origin nor a destination there) were projected using trip distribution patterns based upon census data and traffic counts performed at gateways into the Metro area UGB.

**Mode Choice.** This is the step where it is determined how many trips will be by single-occupant vehicle, transit or carpool. The 1994 mode splits would be incorporated into the base model and adjustments to that mode split may be made for the future scenario, depending on any expected changes in transit or carpool use. These considerations are built into the forecasts used for 2015. In the Tigard area, the 2015 model assumes

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<sup>3</sup> *Trip Generation Manual*, Institute of Transportation Engineers.

approximately two percent would use transit and average vehicle occupancy would be about 1.24 passengers during the evening peak period.

**Traffic Assignment.** In this process, trips from one zone to another are assigned to specific travel routes in the roadway network, and resulting trip volumes are accumulated on links of the network until all trips are assigned.

Different models are actually used for auto assignment versus transit assignment. Various techniques exist for auto assignment, such as all-or-nothing, stochastic, incremental capacity restraint and equilibrium capacity restraint. The EMME/2 package, among others, uses the equilibrium capacity restraint technique, which is considered to produce the most realistic network traffic loading of all the techniques. With this technique, the auto trips are assigned iteratively to the network in such a way that the final traffic loading will closely approximate the true network "equilibrium." Network equilibrium is defined as the condition where no traveler can achieve additional travel time savings by switching routes. Between iterations, network travel times are updated to reflect the congestion effects of the traffic assigned in the previous iteration. Congested travel times are estimated using what are called "volume-delay functions" in EMME/2. There are different forms of volume/delay functions, all of which attempt to simulate the capacity restraint effect of how travel times increase with increasing traffic volumes. The volume-delay functions take into account the specific characteristics of each roadway link, such as capacity, speed, and facility type.

**Model Verification.** The base 1994 modeled traffic volumes were compared against actual traffic counts across screenlines, on key arterials and at key intersections. Most arterial traffic volumes are closely replicated, even down to turn movements by the model based upon detailed calibration. Based on this performance, the model was used for future forecasting and assessment of circulation changes.

## MODEL APPLICATION TO TIGARD

Intersection turn movements were extracted from the model at key intersections for both year 1994 and future scenarios. These intersection turn movements were not used directly, but the increment of the future year turn movements over the year 1994 turn movements was applied (added) to existing (actual 1994/1997/1999) turn movement counts in Tigard. Actual turn movement volumes used for future year intersection analysis can be found in the appendix (Level of Service Calculations).